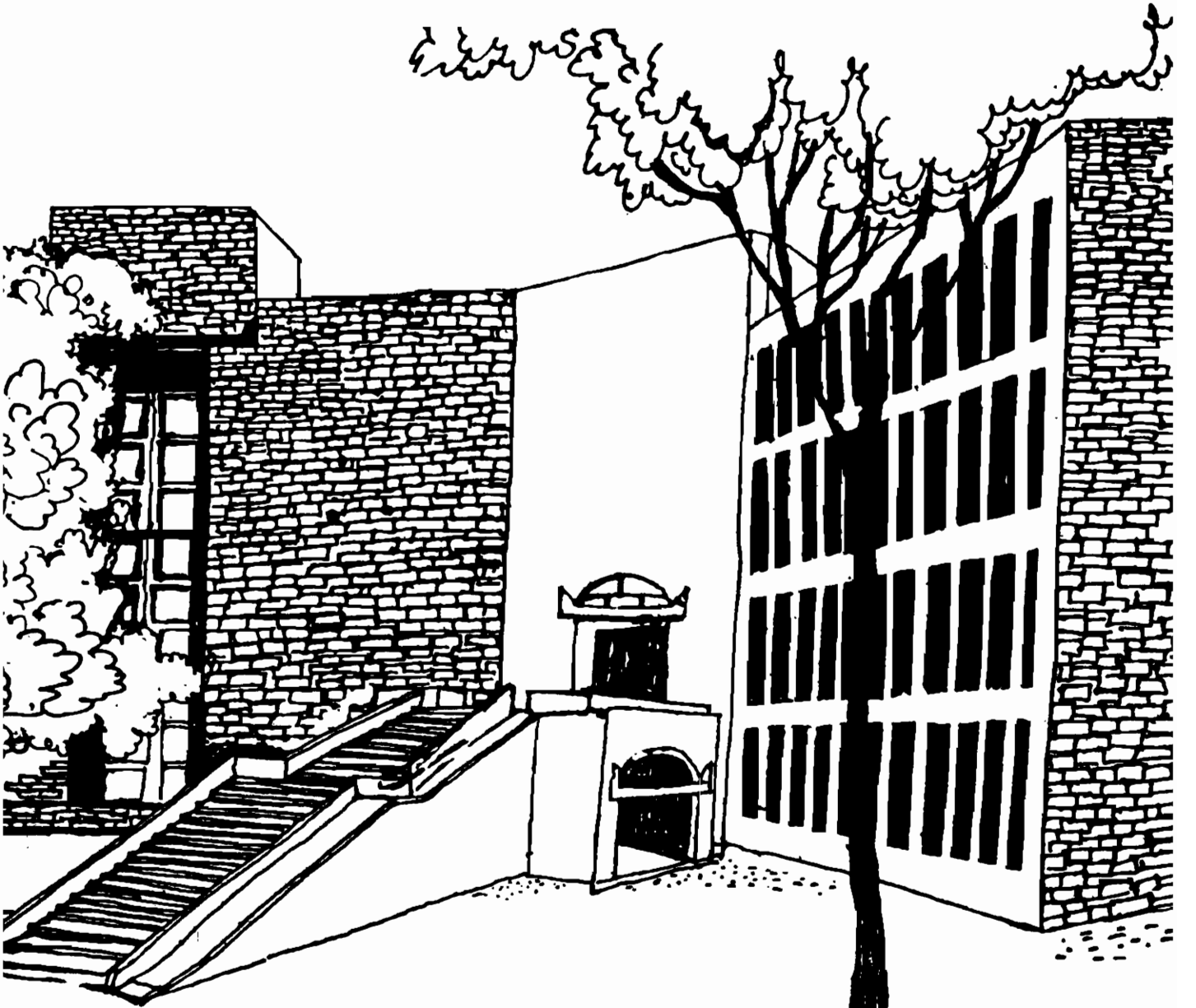




# Working Paper



OPERATING CHARACTERISTICS OF EMPTY SOLAR  
COOKER UNDER CLIMATIC CONDITIONS OF  
AHMEDABAD

By

Girja Sharan  
Vasant R. Pilare

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# Operating Characteristics of Empty Solar Cooker Under Climatic Conditions of Ahmedabad

Girja Sharan

Vasant R Pilare

*Centre for Management in Agriculture*  
Indian Institute of Management, Ahmedabad 380015

## *Abstract*

In this report we present some of the operating characteristics of an empty box solar cooker, under climatic conditions of Ahmedabad. Simulations indicate that cooker will perform satisfactorily during only six out of twelve months.

## **Climatic Conditions**

Global solar radiation on horizontal surface and ambient temperature data was converted into Fourier Series. **Tables 1 and 2** give the coefficients.

## **Plate Temperature and Time Graph**

Simulations are done using model developed by Sharan and Chaudhuri (W.P.# 1423, IIMA). **Figures 1-12** show the rise and fall of plate temperature as the day advances in each of the twelve months under climatic conditions of Ahmedabad.

**Table 3** shows a summary of information obtained from the temperature time simulations. It is seen that cooker will not permit satisfactory cooking in January, July to September, and in November. In these months cooking time available is less than 2.5 hours that is needed to cook *dal*.

## **Cooker Indoor**

**Figure 13** shows the temperature and time graph, when cooker is placed indoor and heating is done by the back-up source. A minimum of 125 W is needed to raise the plate temperature to 120°C. As the source strength is increased, maximum temperature achieved also rises. However, the rise is not in proportional to strength as losses increase more than proportionately. This is only expected, as the cooker is not designed for large inputs.

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We thank Mr. Pankaj Jha for computational assistance.

**Table 1**  
**Fourier Coefficients for Global Solar Radiation Series**  
**Ahmedabad**

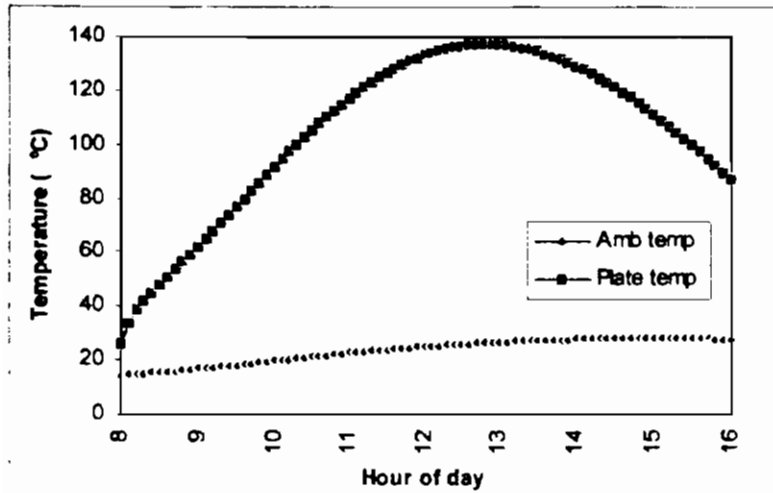
	n	0	1	2	3	4	5	6	Max abs dev (%)
Jan	A	204.00	-338.23	181.47	-42.61	-17.21	14.71	1.42	12.31
	B		-41.58	44.65	-14.90	-10.61	10.81	1.58	
Feb	A	240.63	-392.23	197.26	-35.04	-23.92	13.02	4.58	9.22
	B		-48.16	48.42	-11.77	-14.29	9.54	4.67	
Mar	A	280.71	-448.12	207.89	-23.61	-28.71	8.56	7.25	7.48
	B		-54.54	50.50	-7.34	-16.09	5.54	7.17	
Apr	A	305.33	-476.38	201.47	-9.08	-29.33	2.20	8.17	6.34
	B		-57.02	47.79	-1.48	-15.88	0.53	8.00	
May	A	316.54	-485.23	191.02	-0.06	-26.46	-2.29	7.08	4.85
	B		-62.47	50.45	-0.85	-14.36	-1.55	6.50	
Jun	A	265.71	-405.17	156.52	0.90	-20.75	-1.65	3.75	3.99
	B		-55.21	45.48	-3.41	-9.81	-1.78	4.50	
Jul	A	201.42	-307.80	119.41	1.85	-18.12	-0.55	4.58	5.37
	B		-44.68	37.99	-4.22	-8.01	-0.59	3.75	
Aug	A	185.88	-287.54	117.54	-2.73	-17.17	0.91	3.58	5.31
	B		-45.99	40.92	-5.92	-9.38	0.55	5.17	
Sep	A	230.83	-364.81	162.70	-13.87	-23.04	5.32	4.42	6.64
	B		-49.01	44.06	-4.69	-14.94	4.43	6.08	
Oct	A	240.25	-388.49	189.58	-29.41	-23.54	9.85	5.83	9.11
	B		-47.73	46.29	-8.95	-15.08	8.26	5.33	
Nov	A	207.21	-342.21	181.09	-40.68	-17.42	13.32	2.25	8.60
	B		-39.12	40.72	-11.58	-11.55	9.81	2.33	
Dec	A	190.88	-318.26	174.50	-44.73	-13.92	14.03	0.58	15.88
	B		-38.45	42.04	-15.03	-9.38	10.78	0.67	

**Table 2**  
**Fourier Coefficients for Air Temperature Series**  
**Ahmedabad**

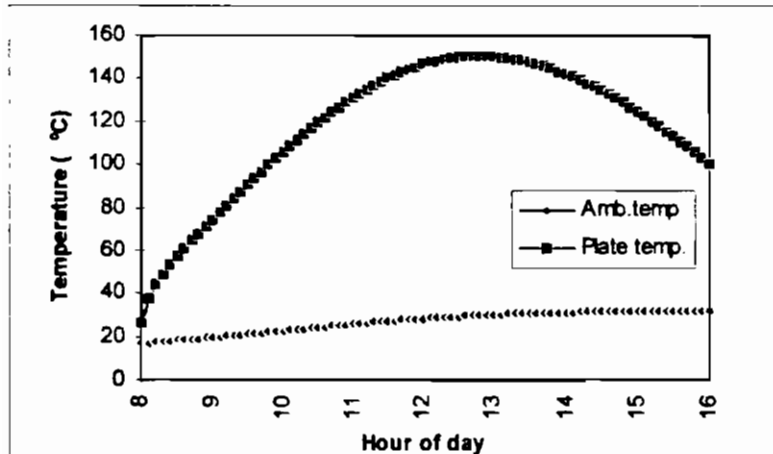
	n	0	1	2	3	4	5	6	Max abs dev (%)
Jan	A	20.01	-3.92	0.89	-0.44	0.23	0.07	-0.18	10.92
	B		-6.07	1.63	0.35	-0.48	0.20	0.08	
Feb	A	23.12	-3.97	0.98	-0.36	0.35	0.14	-0.27	9.75
	B		-6.70	1.67	0.60	-0.48	0.17	0.15	
Mar	A	27.37	-3.54	0.79	-0.40	0.20	0.17	-0.18	4.91
	B		-6.42	1.36	0.59	-0.44	-0.05	0.09	
Apr	A	31.55	-2.94	0.69	-0.30	0.16	0.13	-0.08	2.21
	B		-6.12	1.15	0.55	-0.31	-0.05	0.06	
May	A	33.77	-2.53	0.31	-0.08	0.11	0.13	-0.04	1.33
	B		-5.90	1.20	0.39	-0.14	-0.09	0.03	
Jun	A	31.83	-2.08	0.06	0.11	0.04	0.00	-0.08	0.85
	B		-3.74	1.07	0.20	-0.12	-0.08	0.06	
Jul	A	28.74	-1.24	0.08	0.04	0.00	0.01	-0.04	0.71
	B		-2.07	0.54	0.10	-0.12	-0.03	0.06	
Aug	A	28.03	-1.12	0.12	0.02	0.03	0.01	-0.03	0.66
	B		-2.07	0.50	0.06	-0.10	-0.03	0.04	
Sep	A	28.00	-1.76	0.34	0.00	0.04	0.01	-0.08	1.21
	B		-2.60	0.71	0.13	-0.17	-0.03	0.08	
Oct	A	27.69	-4.02	1.02	-0.13	0.03	0.07	-0.18	3.86
	B		-4.65	1.33	0.55	-0.51	0.01	0.19	
Nov	A	24.27	-4.73	1.27	-0.26	0.03	0.07	-0.17	7.31
	B		-5.31	1.48	0.48	-0.65	0.11	0.23	
Dec	A	21.03	-4.20	0.99	-0.26	0.20	0.00	-0.23	9.28
	B		-5.47	1.70	0.31	-0.58	0.08	0.16	

<b>Table 3</b>					
<b>Summary of Simulated Results</b>					
<b>Months</b>	<b>Time to reach 120°C (hrs)</b>	<b>Maximum Temp. (°C)</b>	<b>Time to fall below 120°C (hrs)</b>	<b>Total available time (hrs)</b>	<b>Available cooking time (hrs)</b>
Jan	11.20	137	14.5	3.3	1.8
Feb	10.60	150	15.2	4.6	2.4
Mar	10.00	162	15.7	5.7	3
Apr	9.70	167	16.0	6.3	3.3
May	9.50	169	16.0	6.5	3.5
Jun	10.20	149	15.7	5.5	2.8
Jul	11.90	124	14.0	2.1	1.1
Aug	12.80	120	13.2	0.4	0.2
Sep	10.70	140	15.0	4.3	2.3
Oct	10.40	150	15.2	4.8	2.6
Nov	10.90	140	14.6	3.7	2.1
Dec	11.40	133	14.3	2.9	1.6

Note : Total available time-duration for which temp. stays above 120°C during day.  
 Available cooking time-duration for which temp. stays above 120°C till 1:00 P.M.

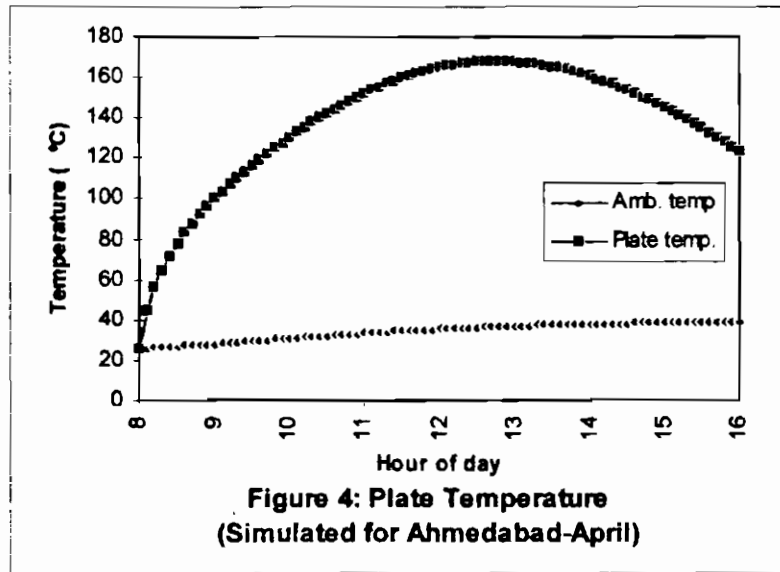
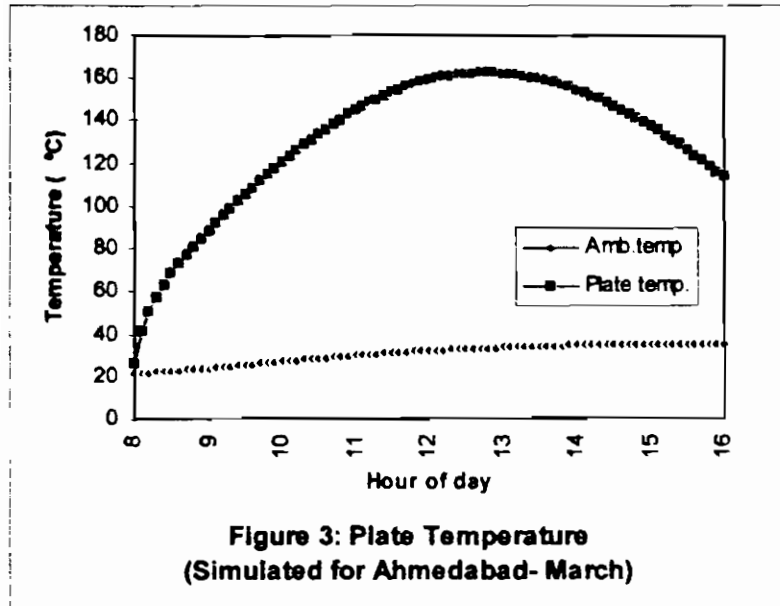


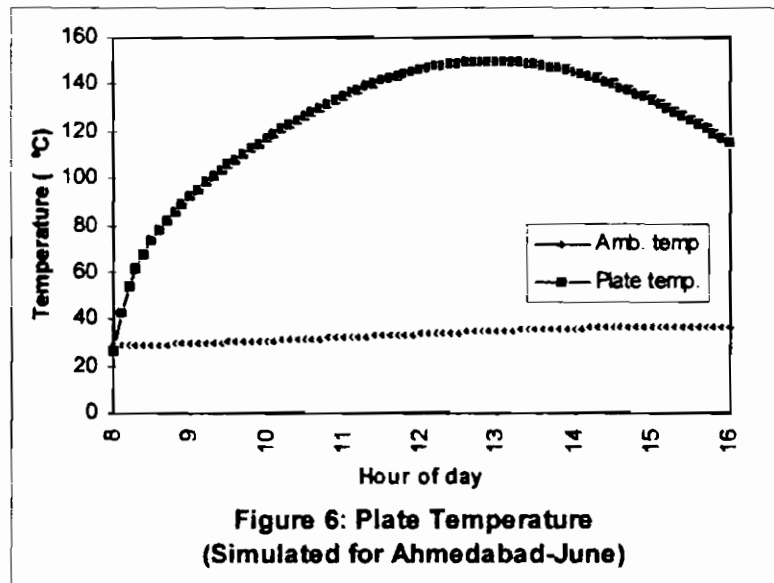
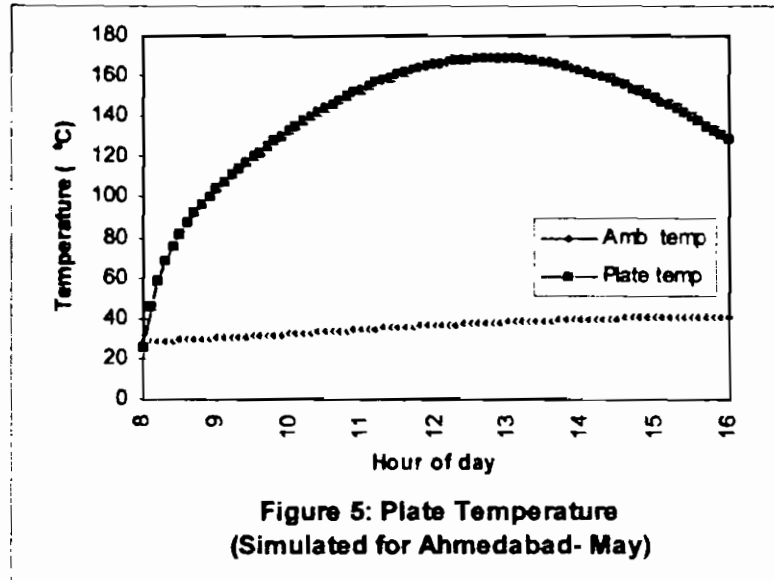
**Figure 1: Plate Temperature  
(Simulated for Ahmedabad- January)**



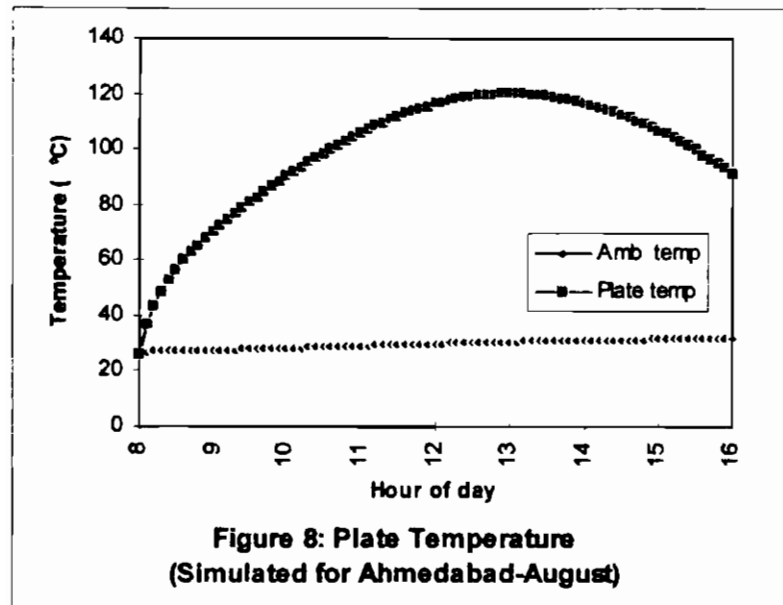
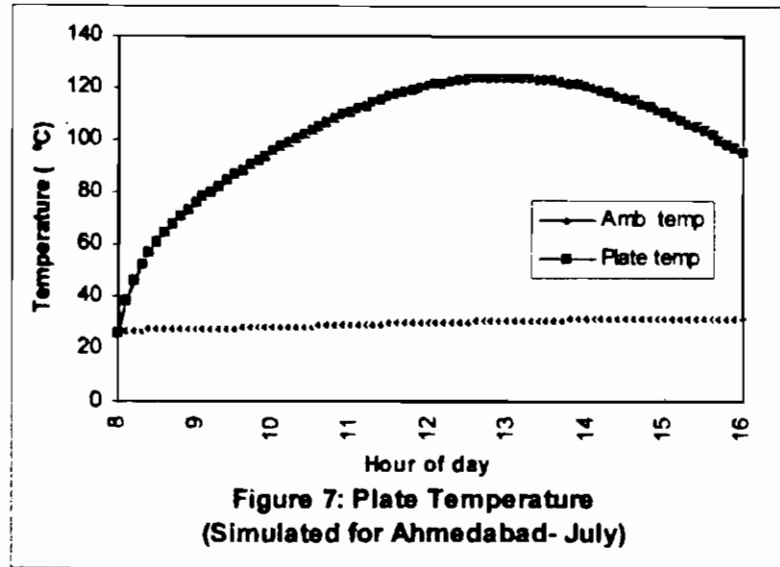
**Figure 2: Plate Temperature  
(Simulated for Ahmedabad- February)**

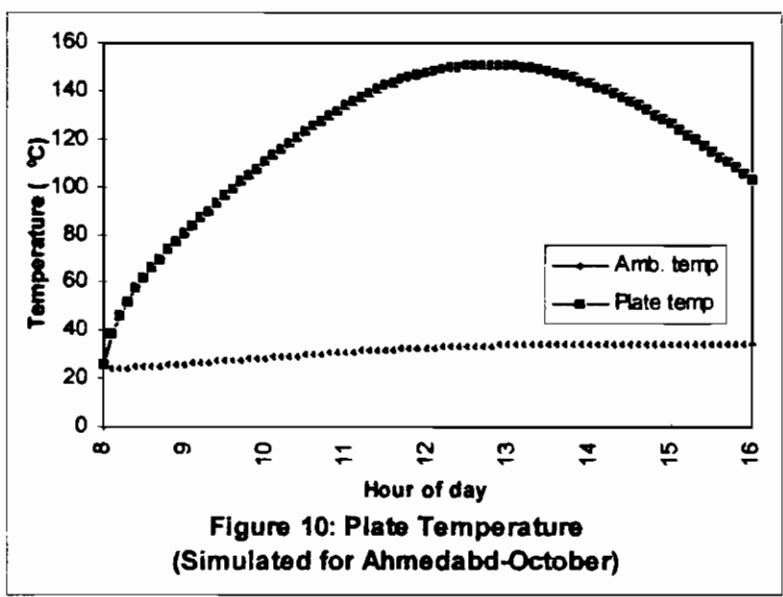
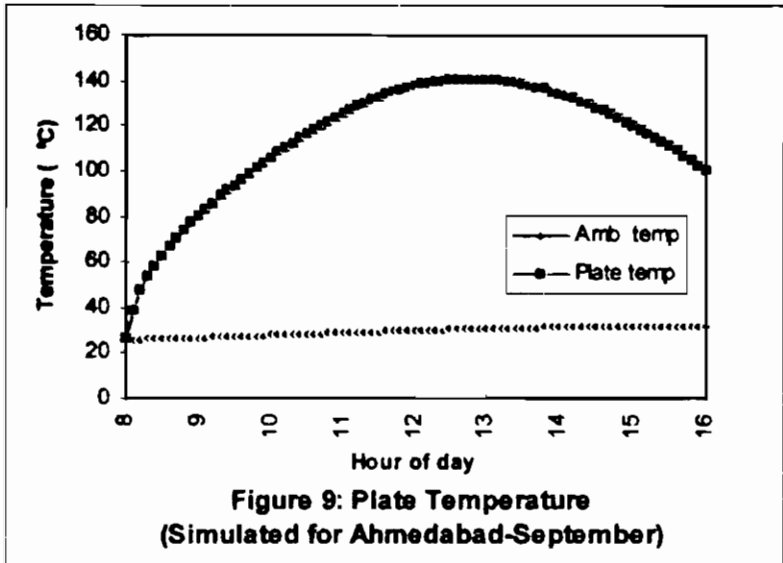


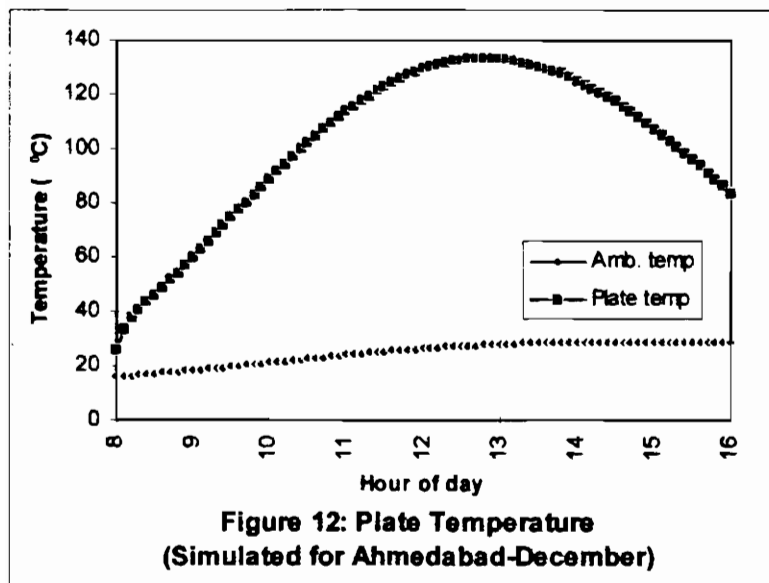
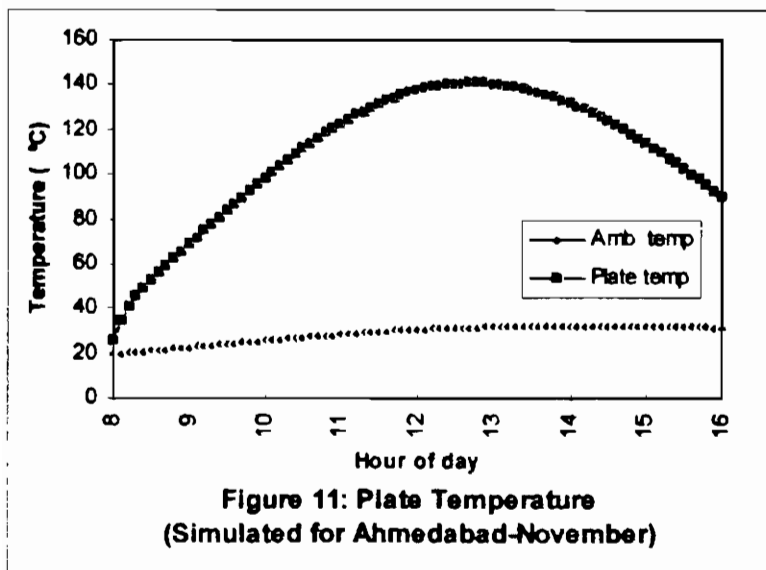




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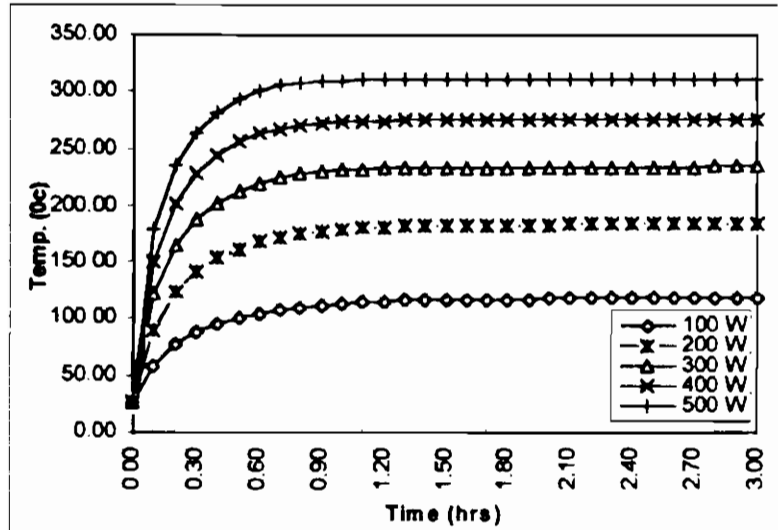


Figure 13(a): Plate Temperature (Indoor Cooker Simulation)

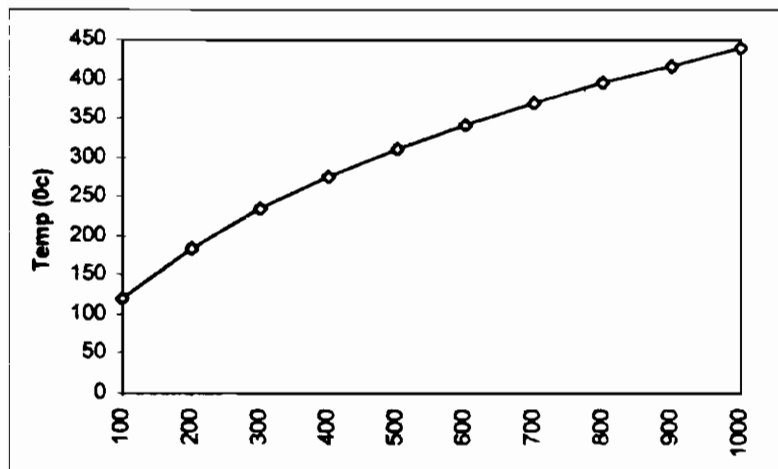


Figure.13(b): Maximum Plate Temperature (Indoor Cooker Simulation)

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